EUROPEAN CENTRAL BANK

EUROSYSTEM

# Demographics and the behavior of interest rates

**(C. Favero, A. Gozluklu and H. Yang)**

**Discussion by**

**Michele Lenza**
**European Central Bank and ECARES-ULB**

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# Persistence in interest rates

- Interest rates are very persistent, characterized by a relevant share of low frequency fluctuations
- This poses challenges to modeling, in particular by using VAR techniques
- Sims (1992, 1996) identified a set of pathologies for VARs which turn out to be very relevant for interest rates (and other very persistent variables).
- I will highlight the importance of the empirical contribution, in the context of this debate on how to address “persistence” in empirical models
- Then, I will have a few remarks

# Pathologies of VAR (Sims, 1992 and 1996). A simple example

- AR(1): $$y_t = c + \rho y_{t-1} + \varepsilon_t$$

- Iterate backwards: $$y_t = \underbrace{\rho^t y_0 + \sum_{j=0}^{t-1} \rho^j c}_{DC} + \underbrace{\sum_{j=0}^{t-1} \rho^j \varepsilon_{t-j}}_{SC}$$

- Model separates observed variation of the data into
  - DC: deterministic component, predictable from data at time 0
  - SC: unpredictable/stochastic component

- If ***ρ = 1***, DC is a simple linear trend: $$DC = y_0 + c \cdot t$$

- Otherwise more complex: $$DC = \frac{c}{1-\rho} + \rho^t \left( y_0 - \frac{c}{1-\rho} \right)$$

- Simulate sample paths from

$$y_t = c + y_{t-1} + \varepsilon_t, \qquad \varepsilon_t \sim N(0,\sigma^2)$$

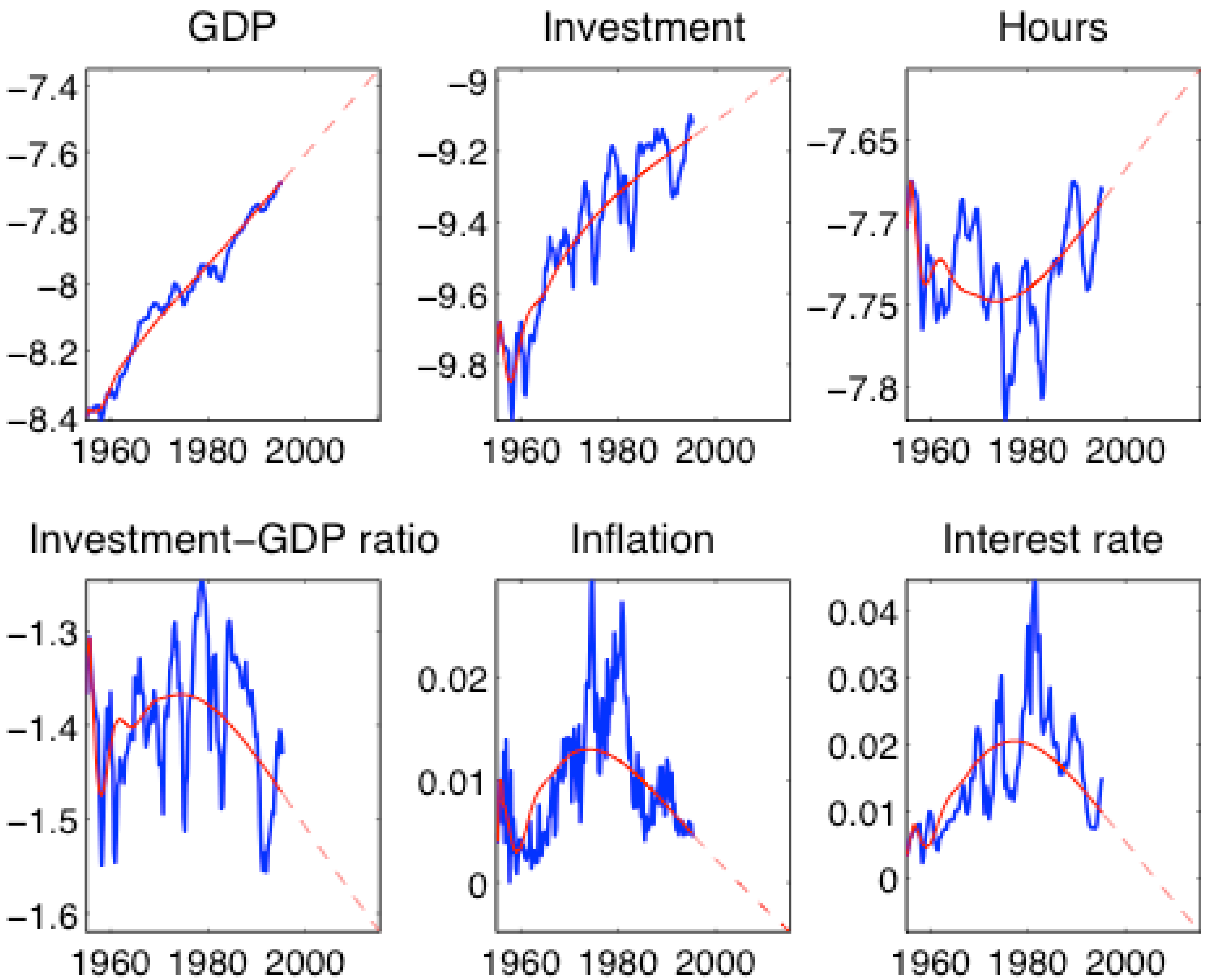
- Compute OLS estimates of parameters and plot implied deterministic component

Main lessons:

- Flat-prior estimates imply that the average growth rate ***in the next T periods*** is likely to be quite different from ***the last T periods***
- *Deterministic components tend to explain too much sample variability*

- Problem more severe with VARs
  - Implied deterministic component is much more complex than in AR(1) case
  - A VAR with k variables and n lags has k*n roots and can perfectly fit an arbitrary collection of k*nth order polynomials
  - Example: 7-variable VAR(5) with quarterly data (1955:I – 1994:IV)
  - Flat prior

# Deterministic components in flat prior VARs (Giannone, Lenza and Primiceri, 2014)



# Pathology of (flat-prior) VARs (Sims, 1996 and 1998)

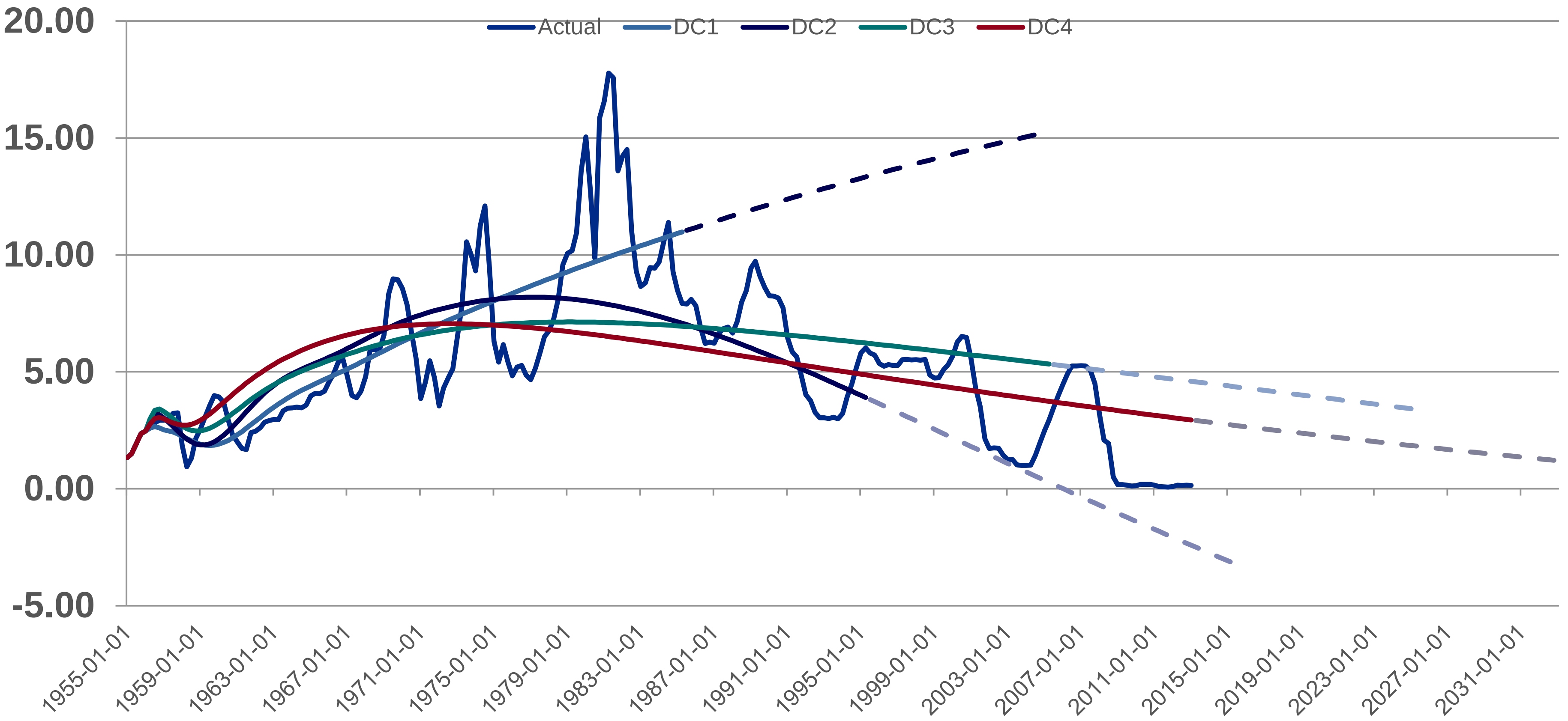
- OLS/MLE has a tendency to “use” the complexity of deterministic components to fit the low frequency variation in the data

- Possible because inference is typically conditional on $\boldsymbol{y_0}$
  - No penalization for parameter estimates that make initial conditions as highly implausible draws from the unconditional distribution of the variables
  - Parameter estimates may, then, imply steady states or trends very far away from the initial conditions!

➠ Flat-prior VARs attribute an (implausibly) large share of the low frequency variation in the data to deterministic components

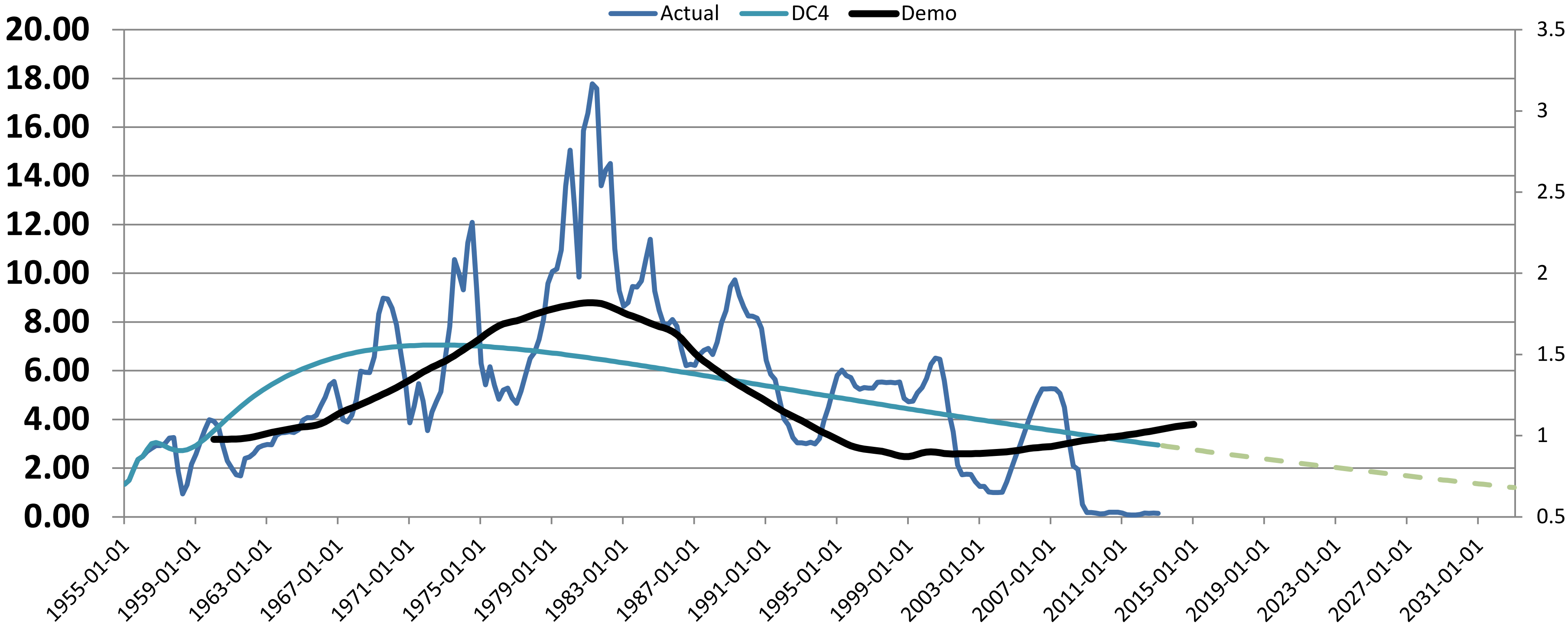
➠ Typically a problem: the estimated model provides very inaccurate out-of-sample forecasts

# Example of out-of-sample forecasts of short-term interest rates - deterministic




Deterministic components and forecasts: generally, poor out-of-sample accuracy of models which assign this importance to deterministic components

# Demographic variable in this paper




Several solutions have been devised in the literature to address this issue.

For example, use priors centered on non-stationarity

**This paper**: model the low frequency component by means of demographic variable (black solid line, inverted) and exclude if from the VAR analysis

# Summary of the paper

- Model similar to a “Factor” model for short and long-term interest rates ($i_t$)

$$i_t = a + b*X_t + b*MY_t$$

$$X_t = d + f*X_{t-1} + e_t$$

$X_t$ : two observed macroeconomic factors (real and nominal) and three unobserved “term-structure” factors

$MY_t$ : exogenous demographic variable (middle age/young). Captures the ratio of savers over dissavers. When high, interest rates have to be low to balance saving flows (and viceversa)

Effectively, the variable $MY_t$ is an exogenous permanent factor meant to capture the low frequency component of interest rates

Persistent component of interest rates: “equilibrium rate”

Cyclical component: Taylor type rule

# Summary of the paper

- Evaluation of the out-of-sample forecast accuracy
  - Forecast conditional on actual future demographic variable

How would these forecasts look by using the real-time "future paths" of the demographic variable?

  - Better than model without deterministic component (Macro ATSM)
    - Model excluding demographic variable; in theory persistence in rates captured by persistent unobserved level factor

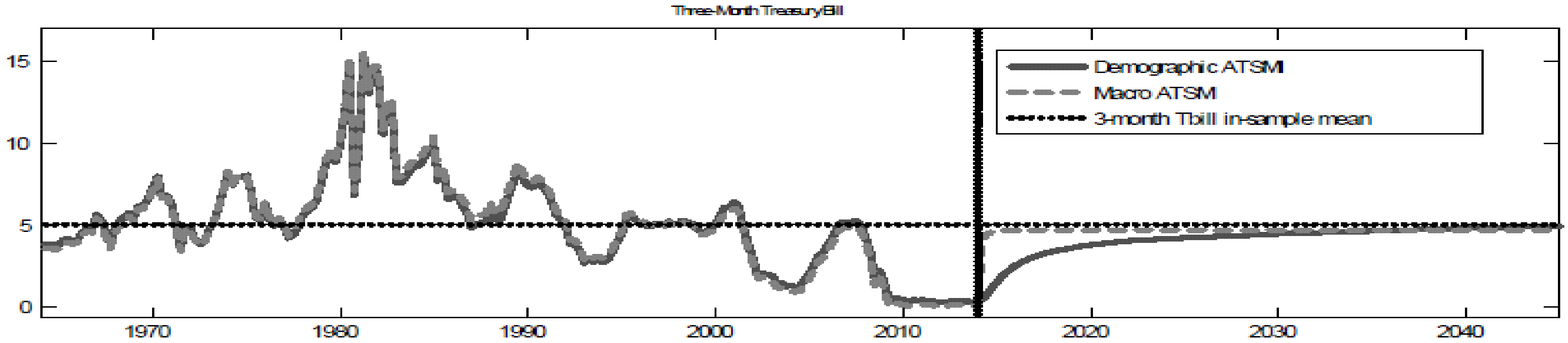
- The demographic variable provides an accurate estimate of the low frequency fluctuations of the interest rates

- Implication for secular stagnation? Can do pretty accurate long-run forecasts of demographic variables! This model can potentially be used to project the path of interest rates, conditional exclusively on demographic variable, far in the future (stationary VAR)

# Comment 1: how good a benchmark is the Macro ATSM?

- Out-of-sample analysis is a crucial part of this study: validate the characterization of the low frequency of interest rates by means of the demographic variable

- But, is the Macro ATSM a good enough benchmark? (level factor to capture persistence)




- Virtually no persistence captured in Macro ATSM. Maybe benchmark should be a better model, with more chance of capturing persistence/low frequency

- In the literature, other solutions to address the issues raised by the pronounced low frequency fluctuations of interest rates

  – Imposition of priors, centered on non-stationarity (sum-of-coefficients priors) or “Priors for the long-run” (Giannone, Lenza and Primiceri, 2014: favoring “common trends”); allows also to include more lags.

  – Can also add the “arbitrage restrictions” as priors

# Comment 2: alternative interpretations for long-run components of interest rates?

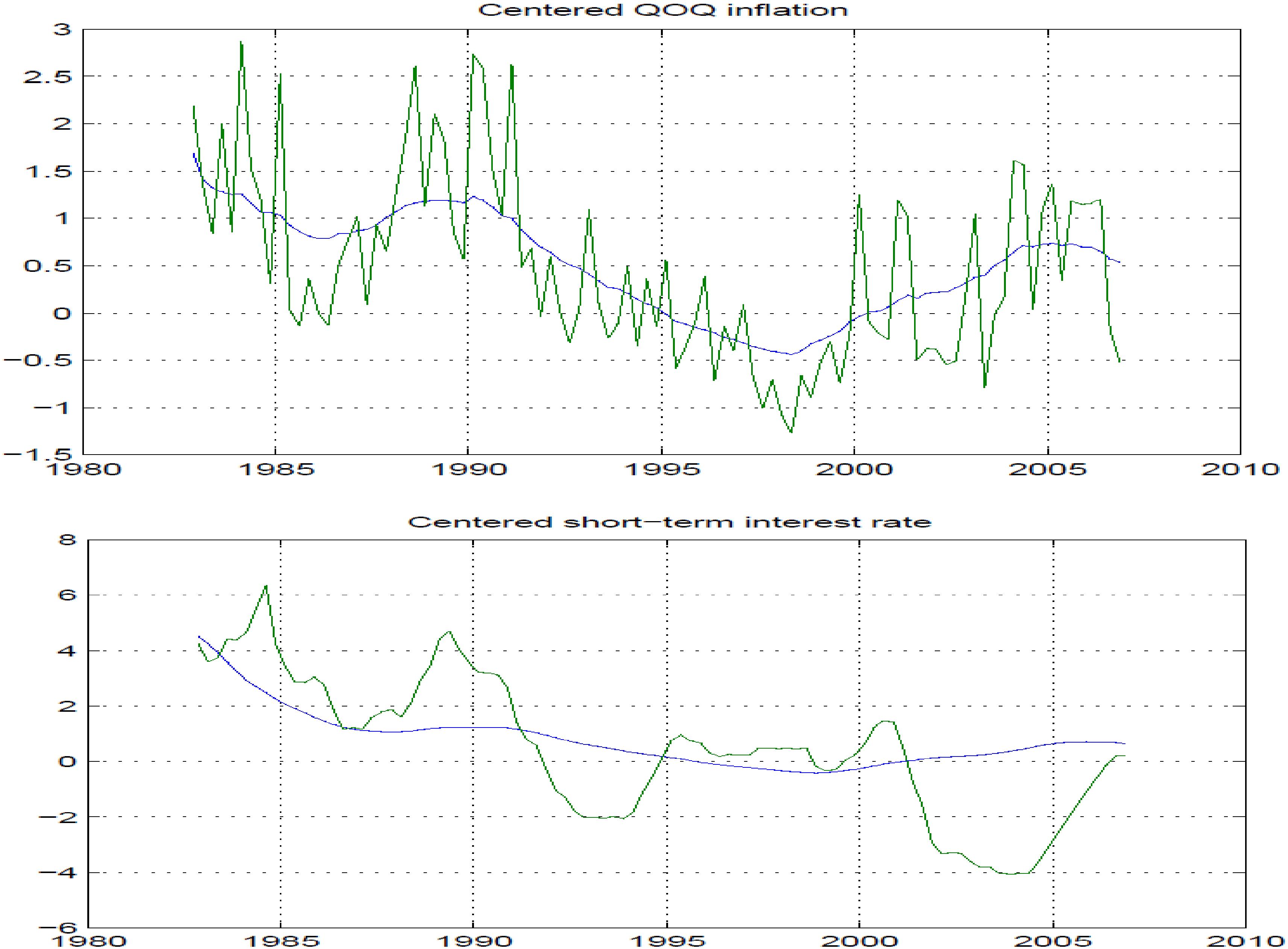
- The paper discusses also alternative explanations for the long-run component of interest rates
  - In particular, long-run component of "core" inflation (Cieslak and Povala, 2015): very long discounted sum of past inflation

- To see that the low frequency component of inflation is a valid benchmark, let's look at a standard NK-DSGE model
  - low frequency component of inflation modeled by means of a persistent inflation targeting shock (sample 1982-2006, Cogley, Primiceri and Sargent, 2010)

- Standard three equations model, fits the data well

- What happens if we zero-out all the shocks apart from the inflation targeting shock?

# Comment 2: alternative interpretations for long-run components of interest rates?



# Comment 2: alternative interpretations for long-run components of interest rates?

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  - In particular, long-run component of "core" inflation (Cieslak and Povala, 2015): very long discounted sum of past inflation
  - In "forecasting" equation, significantly loaded but slightly "less good" than demographic
- However, this inflation component is a discounted moving average of past inflation.
- Lagging signal for current permanent component of inflation. Ideal would be a moving average including also future inflation, but unfeasible!
- The literature on Dynamic Factor Models (Cristadoro et al. 2005) has suggested how to address this issue
- Idea: use variables leading inflation in order to proxy for missing "future" inflation in average over past, present and future inflation
- Example on euro area data (dataset: 150 sub-components of Harmonized Index of Consumer Prices)

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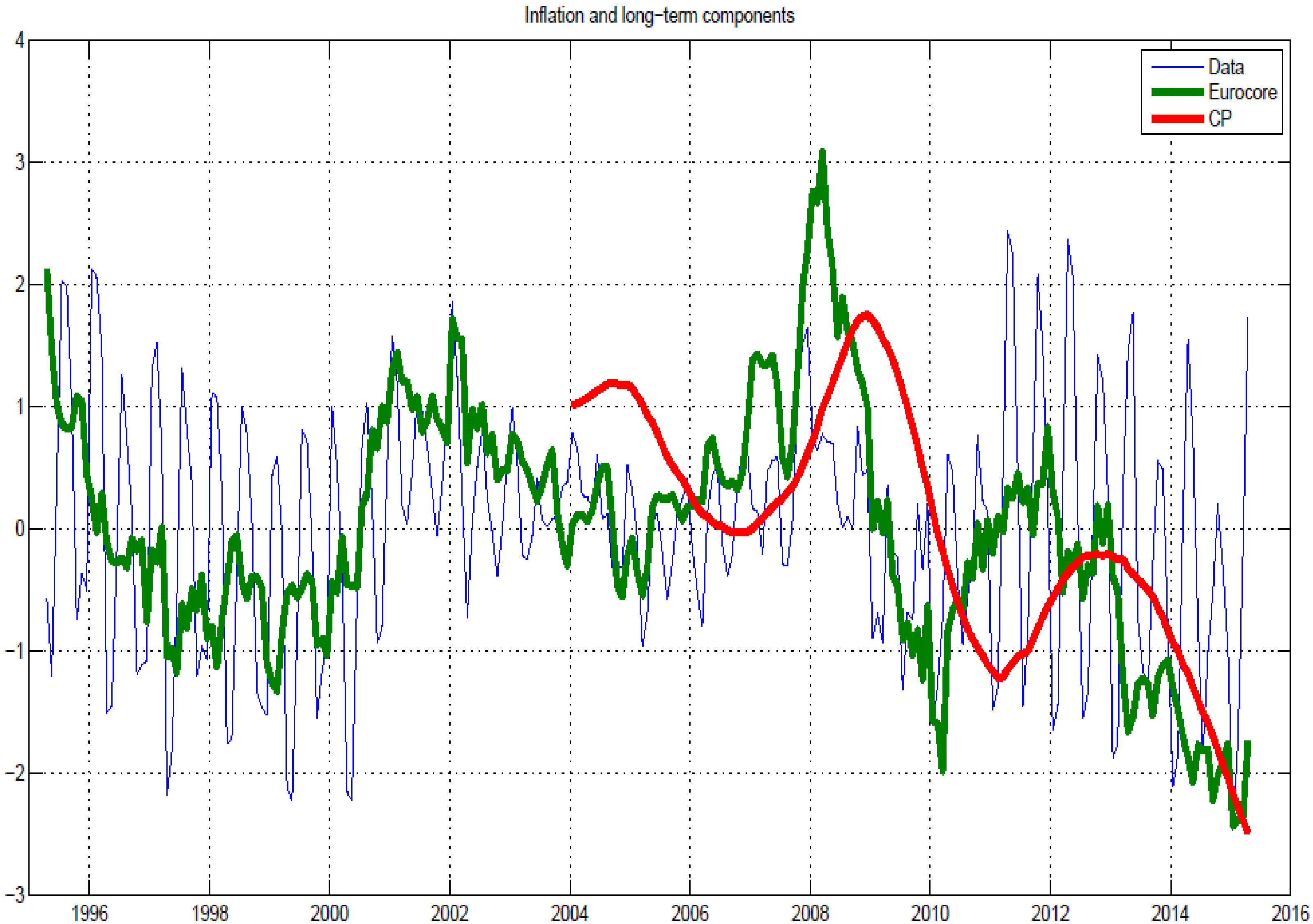

# Comment 3: what about other countries?

- Very strong global correlation of interest rates
- To what extent does this correlation reflect the correlation in demographics?
- Panel regression in the paper. Evidence of (statistically significant) negative relationship, on average across countries
- Let’s “open the black-box” of the panel regression to see if there is some recognizable pattern
- Plot country (short-term) nominal interest rates (blue), (inverted) demographic variable (red) and US short-term interest rate (green)
- Standardized/centered

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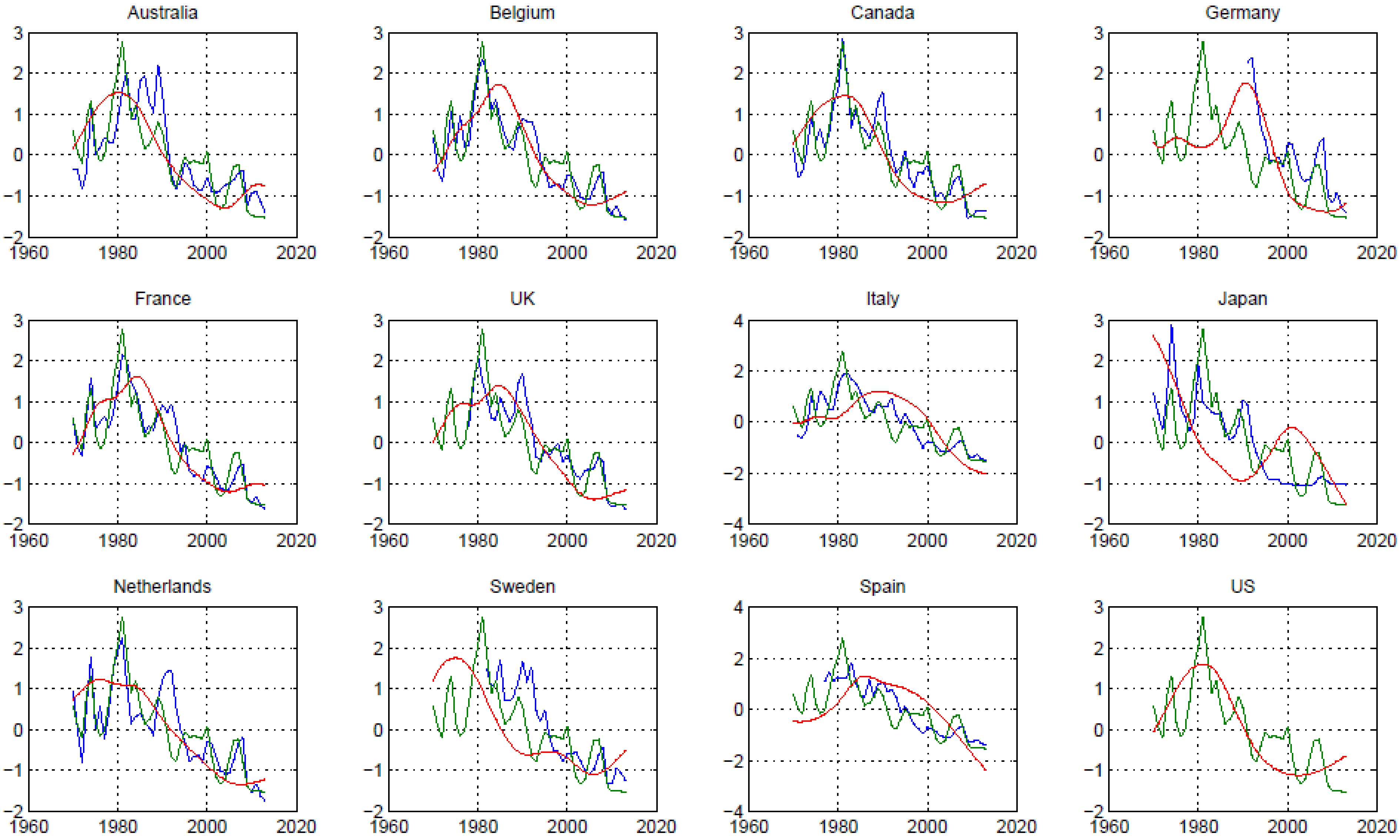

# Comment 3: what about other countries?

- Perfect alignment in some countries
- In many European countries, seems that the tightest relationship is not with the demographic variable, but the US interest rate (US demographic)
- Demographic variable inappropriate for Europe?
- Policy implication: for monetary policy in the euro area, don't look at euro area demographics, but at US demographics?

# Conclusion

- I like this paper
- It models the low frequency component of interest rates in an innovative way, grounded on economic theory
- It conducts serious out-of-sample validation exercises in order to support empirically the use of the demographic variable
- In my comments I have highlighted some potential extensions, but I think that the idea is robust and will survive also after further analysis